

**Controlled-Source Study of the structure of the Seattle Basin and Tacoma Basins - SHIPS (Seismic Hazards Investigations of Puget Sound) 99: Collaborative Research (USGS, OSU, UTEP)**

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Elements I and II

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## **Introduction**

The overall objectives of the Seismic Hazards Investigation of Puget Sound (SHIPS) are to understand both earthquake effects (the influence of the regional velocity structure on strong ground motion) as well as the distribution and size of earthquake sources (fault locations and geometry) in this urban area. The cities of Olympia (state capital), Seattle, Tacoma, Everett, Bellingham, and Victoria (Provincial Capital) and Vancouver, Canada are underlain in part by thick sequences of Cenozoic sedimentary rocks that amplify and focus seismic energy, thus increasing ground shaking during an earthquake. The 1999 phase of SHIPS involved the acquisition of wide-angle seismic refraction and reflection data along an east-west transect through Seattle (Figure 1). These data will be used in mapping and modeling areas of expected strong ground shaking, and to better determine the regional velocity structure and tectonic framework of the Puget Sound Region.

The controlled source data for this phase were acquired in mid-September of 1999. The data are just now in the process of being edited and merged. Here we report on the experiment and present representative record sections.

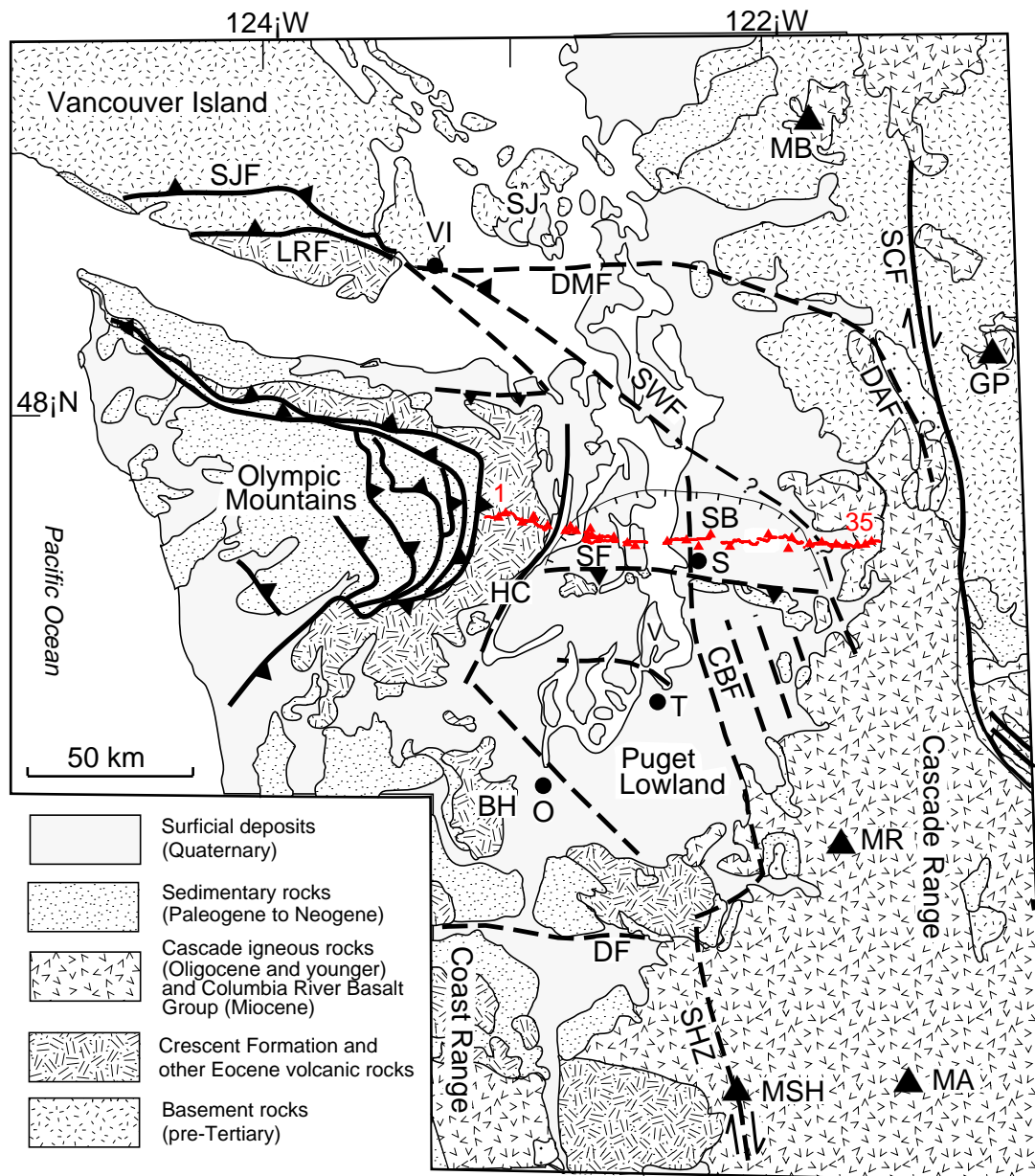


Figure 1. Schematic geologic map of northwestern Washington from Johnson et al., (1999). Location of shots (red triangles and receiver stations (red dots) for the 1999 experiment are overlain on the map. The seismic profile crosses through the city of Seattle (S) and the Seattle Basin (SB).

## **Data Acquisition**

Data acquisition was completed in mid-September of 1999. During the experiment ~1000 seismographs were deployed at a nominal station spacing of 100 m from the Olympic Peninsula to the Cascades (Figure 1). Instrumentation included 440 Texans, 200 Canadian PRSs, 129 SGRs, and 231 Refteks, and 8 OBS deployed in Puget Sound. Of these, ~250 recorded with 3-components. These instruments recorded data from 38 explosions ranging in size from 25 lbs to 2800 lbs that were detonated over three nights. In addition, the Refteks recorded continuously for 3 to 4 days in order to record any local seismicity that may have occurred during the deployment.

## **Results**

Figures 2 and 3 show preliminary record sections from shotpoints 1 and 35 (Figure 1), two of the largest shots on the profile. Both these shots produced energy that carried the length of the line. Most of the smaller shots carried at least 10 km as expected. Overall, data quality is high and all shotpoints produced interpretable data. The data (Figures 2 and 3) show low velocities and a 2 s travel time delay within the Seattle basin.

## **Future Work**

Data reduction is being led by Tom Pratt from the U. S. Geological Survey and is expected to be completed by early in 2000. The data will be archived as shot gathers in SEG-Y format. Geometry information, including the UTM coordinates of the shots and receivers, and the range between shot and receiver will be recorded in each trace header.

Once data reduction is completed, a 2D crustal velocity model will be developed from the data along with a low-fold stacked record. These will be interpreted jointly with the SHIPS data from 1998 and other geological and geophysical data.

## **References**

Johnson, S. Y., S. V. Dadisman, J. R. Childs, W. D. Stanley, 1999, Active tectonics of the Seattle fault, and central Puget Sound, Washington-Implications for earthquake hazards, *Geol. Soc. Am. Bull.*, v. 111, pp. 1042-1053.

## **Non-Technical Summary**

The Seismic Hazards Investigation of Puget Sound (SHIPS) is a seismic study designed to help understand the possible effects of earthquake as well as the distribution and geometry of active faults in urban areas of the Puget Sound region. This is particularly important since the cities of Olympia, Seattle, Tacoma, Everett, Bellingham, and Victoria, and Vancouver, Canada are underlain in part by thick sequences of Cenozoic sedimentary rocks that amplify and focus seismic energy, thus increasing ground shaking during an earthquake. In September 1999, seismic data were successfully acquired along an east-west transect through Seattle. The data are now in the process of being reduced for further analysis.

## Shotpoint 1

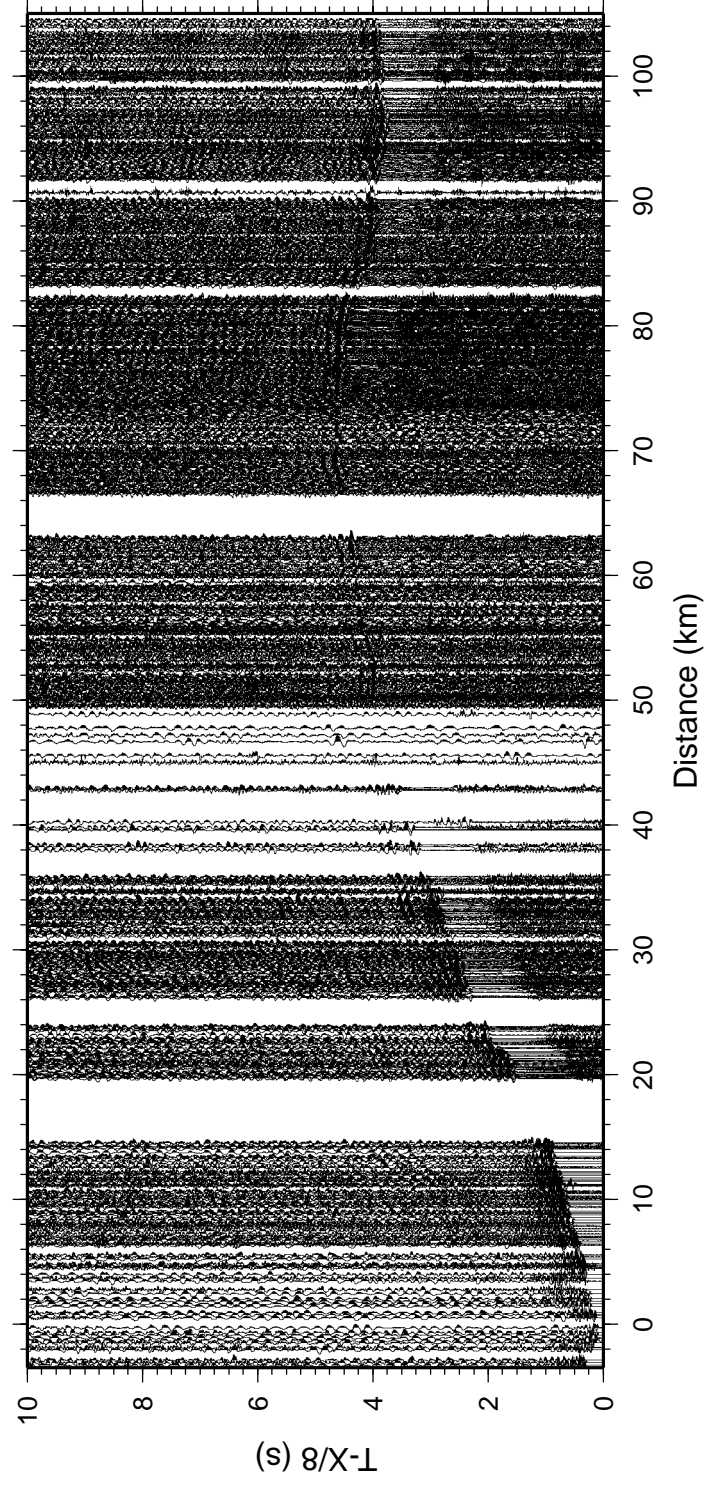


Figure 2. Raw, trace normalize data from shotpoint 1 (Figure 1) reduced at 8 km/s. Energy from this 2800 lb shot carried the length of the line.

## Shotpoint 35

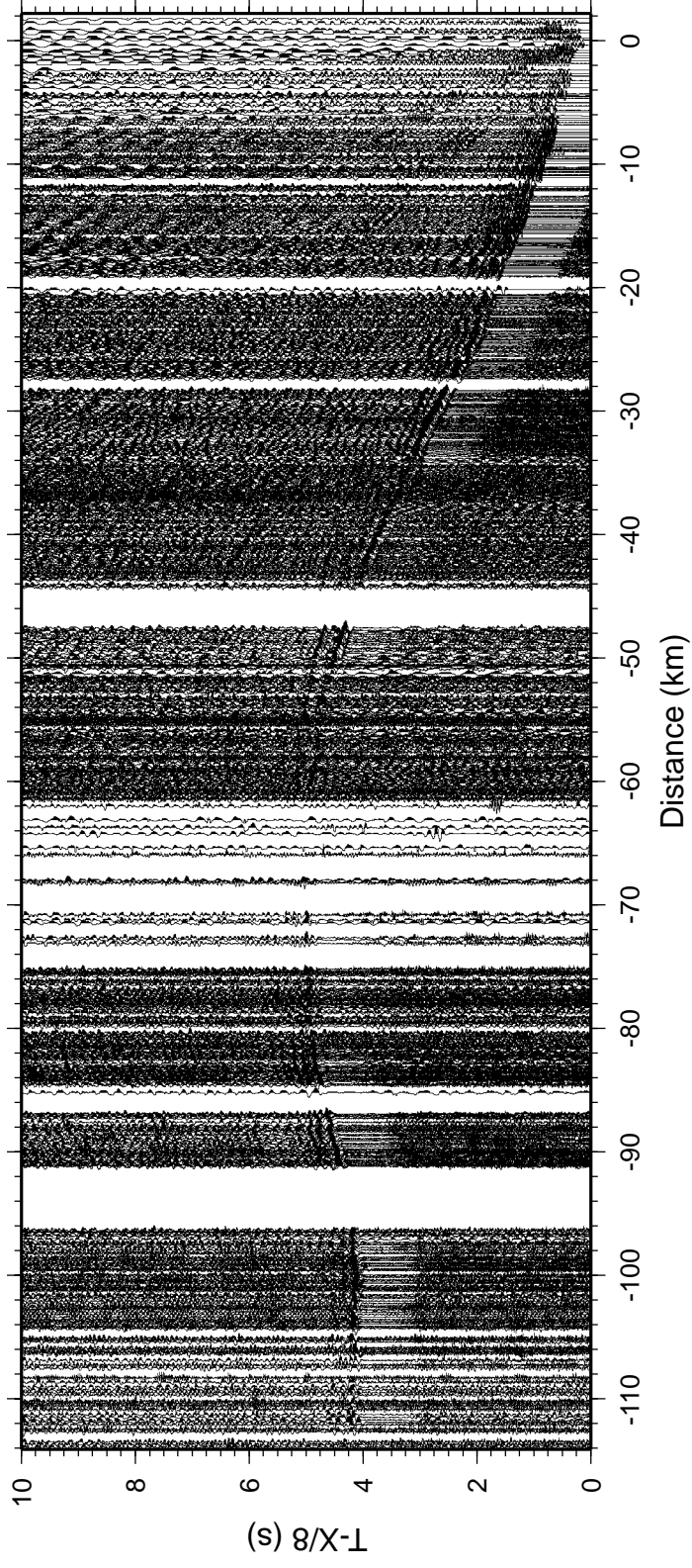


Figure 3. Raw, trace normalize data from shotpoint 35 (Figure 1) reduced at 8 km/s. Energy from this 2400 lb shot carried the length of the line.